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ARTICLE FROM CZECH PERIODICAL DISCUSSES CALCULATION OF PRODUCTION COSTS

The information in this report is taken from extracts from a book by Orlov, Kalkulace vlastnich nakladu v zeleznicni doprave (Calculation of Costs in Railroad Transportation) -- presumbly a Russian book orginally -- which appeared in a supplement to the Czech periodical CZ /Cenove Zpravy?/.

Enterprise accounting and budgeting for the purpose of analyzing production costs, for scrutinizing allocated funds, and for disclosing possible operational economies required a previous breakdown of such costs. This must conform to a set pattern, based on careful scrutiny of such pertinent factors as kind of cost, its relation to the manufacturing process, place of origin, and its variance.

Each workshop or enterprise has a fixed classification of the various costs incurred, and records are kept accordingly; hence, any change in classification should be made only after careful consideration and for grave reasons. Indiscriminate changes could result in inaccurate comparisons between different periods of manufacture and/or erroneous analysis of cost data.

Production costs are divided into two classes: costs of production proper and overhead costs.

Costs of production proper are those easily identifiable as primarily chargeable to the end product. They consist of: direct labor, raw material, auxiliary material, fuel (for production only), steam (for production only), and electric power (for production only).

All other costs, such as costs of organization, administration, servicing the manufacturing process, and amortization of equipment, may be considered as overhead. These are subdivided into two groups, basic and administrative.

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Basic overhead comprises wages of nonproductive labor; salaries of engineers, designers, technicians, officials, and lower-level auxiliary personnel; workshop repairs; work clothes or cost of special work clothing furnished to the workmen; and supplies.

Administrative expenses include all costs of management; salaries of supervisory and clerical personnel; postal and telegraph expenses; office supplies; heating of office quarters; repairs of office quarters and equipment; and petty cash.

If the enterprise has several workshops, overhead expenses are subdivided into burden or factory-service costs, and overhead expenses proper, i.e., of the enterprise as a whole. In calculating the production cost of end items, only those items of burden or factory service which are readily identifiable as pertaining to the work may be used. Obviously some of these cannot be so identified, as they pertain to the entire operation or to only one specific process of it.

Production costs for individual items are divided into direct and indirect costs. Direct costs are those which are wholly a part of the production cost and chargeable to end items involved. Indirect costs comprise all the expenses which cannot be apportioned to individual items. In order that actual costs may reflect the true picture, these indirect costs must be apportioned among the departments or items benefiting from them.

Direct costs must not be confused with costs of production proper, nor indirect costs with overhead costs. For example, in a factory manufacturing a single product, all expenses, whether cost of production or factory service, are direct costs. But if this same enterprise manufactures several products, auxiliary material might easily become an indirect cost.

The character of the plant under consideration, the complexity of the processes involved, the number and kind of products produced, and the scope of the plant's accounting and statistical records determine the possible division between direct and indirect costs. As a general rule, the costs of production, i.e., raw materials and labor, are considered direct costs and all burden or factory-service items as indirect costs.

In addition to the above costs, there are so-called variable costs, which are proportionate to or depend on the volume of goods produced; and fixed or capacity costs, which do not fluctuate with volume.

This division is based on the fact that the first group is directly contingent on the extent of the operations, and increases or decreases in proportion to the number or amount of products manufactured, whereas the second group remains static. In the allocation of the latter group, as the output increases, the ratio of the fixed expenses per end item decreases.

The term "calculation of actual costs" means budget of actual production costs and includes planning and historical calculations.

Planning calculations are based on production goals. Financial requirements are based on technical norms, established on the basis of labor productivity and other indexes of the production and financial plan.

The purpose of planning calculations is to budget production costs in the enterprise for the next period. These particular figures are necessary for the control of quality in the projected plan; for the allocation of funds; for the organization of the economic activity of the enterprise on the basis of the principle of self-sufficiency; and for setting up performance goals for projected reconstruction and rationalization.

Historical calculations are made after the current accounting period ends, or after the completion of a specific order. These are based on actual expenditures and statistical deductions. These historical calculations have definite purposes: to furnish material for definite conclusions on the results of the economic activity of the enterprises; to indicate whether expended funds fall under the original allocations; to evaluate the effective use of equipment; and to evolve methods of further decreasing actual production costs.

Both the planning and the historical calculations involve two systems: process costing, or costing on an individual basis. Process costing is concerned with all the expenses connected with a great number of end items, either manufactured or to be manufactured, in a given and definite time period. Individual calculation is concerned with all the costs involved in the production of one item, or one production order. At the same time, individual calculations must reflect the special situation in a given enterprise: whether the plant makes one or several items; and whether the complete manufacturing process from raw materials to the finished product takes place there, or only part of it. All these factors influence the accounting methods used.

In enterprises manufacturing one kind of product, the cost figure may easily be ascertained by applying the following formula: $C = \frac{E}{P}$. (C = unit cost; E = total expense; P = quantity of product).

In enterprises where a great variety of products are made, or a large amount of unfinished products remains on hand as work in process, the calculation becomes more complicated. Adjustments have to be made from period to period; the number of finished items must be increased or decreased depending on the carry-over at the beginning and end of the cost period; and the amount expended must be adjusted in like manner, as some expenses may have been incurred in a prior cost period.

In these enterprises the products may have a varying direct cost, and the indirect or factory-service cost must be allocated in accordance with common practice. There is no method which could be used uniformly for distributing the indirect costs in all types of enterprises. Ordinarily, indirect costs are allocated on the basis of labor cost, direct cost, cost of raw material, prime cost with cost of raw materials deducted, man-hours of productive labor, or machine-hours used in manufacturing various items. The particular technological process of the enterprise in question, the working conditions, and the proportions existing between direct and indirect expenses may govern the selection of any of these methods.

Allocation of various costs follows a similar pattern. For example, social security payments are allocated in proportion to wages; the "freight and cartage in" cost is allocated in proportion to weight of raw materials and semi-finished and finished products; amortization and current repairs of equipment are allocated on the basis of time used; and depreciation of tools is allocated on the basis of man-hours of productive labor, etc.

Workshop overhead is determined on the basis of actual costs of products made in that workshop only; whereas enterprise overhead costs are allocated on the basis of the production of the entire enterprise. The following example will illustrate.

A certain metallurgical enterprise has three workshops which manufacturing five separate classes of products: A, B, C, D, and E.

Workshop	Kind of Product	No of Items Mfd	Cost of Material (rubles)	Direct Labor (rubles)	Workshop Overhead (rubles)	Enterprise Overhead (rubles)
I	A	2,000	22,000	15,000	- -	- -
	B	1,000	11,000	5,000	4,400	- -
II	C	1,000	28,500	30,000	- -	- -
	D	500	18,500	10,000	6,000	- -
III	E	2,500	5,000	3,500	1,800	- -
For the entire enterprise				63,500		12,700

Workshop I manufactures products A and B: hence, the workshop factory service of 4,400 must be allocated to the total production. Since the labor costs are 15,000 plus 5,000 or a total of 20,000 rubles, the following formula is used:

Product A $\frac{4,400 \cdot 15,000}{20,000} = 3,300$ rubles

Product B $\frac{4,400 \cdot 5,000}{20,000} = 1,100$ rubles

Workshop II has a factory-service cost of 6,000 rubles. It produced two products. The formula follows:

Product C $\frac{6,000 \cdot 30,000}{30,000 + 10,000} = 4,500$ rubles

Product D $\frac{6,000 \cdot 10,000}{30,000 + 10,000} = 1,500$ rubles

Factory service for Workshop III need not be apportioned, as only product E is produced there.

Total enterprise overhead is apportioned on a basis of total direct-labor cost, which amounts to 63,500 rubles. The following application of this formula will illustrate:

Product A $\frac{12,700 \cdot 15,000}{63,500} = 3,000$ rubles

Product B $\frac{12,700 \cdot 5,000}{63,500} = 1,000$ rubles

Product C $\frac{12,700 \cdot 30,000}{63,500} = 6,000$ rubles

Product D $\frac{12,700 \cdot 10,000}{63,500} = 2,000$ rubles

Product E $\frac{12,700 \cdot 3,500}{63,500} = 700$ rubles

The following table shows the unit cost for each class of item manufactured after allocation of factory-service and total enterprise overhead.

Unit Cost Schedule

Cost	A	B	C	D	E
Direct labor (rubles)	15,000	5,000	30,000	10,000	3,500
Raw materials (rubles)	22,000	11,000	28,500	18,500	5,000
Workshop overhead (rubles)	3,300	1,100	4,500	1,500	1,800
Enterprise overhead (rubles)	3,000	1,000	6,000	2,000	700
Total	43,300	18,100	69,000	32,000	11,000
No of products manufactured	2,000	1,000	1,000	500	2,500
Actual cost of product manufactured (rubles)	21.65	18.1	69.	64.	4.4

In enterprises manufacturing one kind of product but using a complex manufacturing process, the simple division of all factory costs and overhead by the number of products cannot be used, as in a given cost period there may be a great variance between the amount of totally finished product (output) and the amount in semifinished state. The calculation of actual costs cannot be made until the costs of the semifinished product are determined. The following example will illustrate the method of calculation in enterprises of this type.

A brickyard prepared 6,600 cubic meters of clay (first stage of manufacture). Of this material, 4,800 cubic meters were processed and 1,800 cubic meters remained. In the second stage of manufacture, molding, the 4,800 cubic meters of clay were formed into 1,600,000 clay bricks, of which 1,500,000 were fired (third stage) and 100,000 remained. After firing there were 1,450,000 usable bricks.

In the first stage of manufacture the cost was: direct labor, 10,000 rubles; material and all other costs, 200 rubles.

In the second stage, molding, the cost was: direct labor, 25,000 rubles; material and all other costs, 5,000 rubles.

In the third stage, firing, the cost was: direct labor, 5,000 rubles; material and all other costs, 10,000 rubles.

Overhead amounted to 12,000 rubles. The allocation was made on the basis of the direct-labor cost. Since the total direct-labor cost was 40,000 rubles, the application of the basic formula used in a former example will produce the following amounts for overhead in each stage of manufacture:

First stage: $\frac{12,000 \cdot 10,000}{40,000}$ = 3,000 rubles

Second stage: $\frac{12,000 \cdot 25,000}{40,000}$ = 7,300 rubles [sic; should be 7,500]

Third stage: $\frac{12,000 \cdot 5,000}{40,000}$ = 1,500 rubles.

Adding the proper amount of overhead to costs of labor and material, the total cost for the 6,600 cubic meters of clay (first stage of manufacture) is 10,000 + 200 + 3,000 = 13,200 rubles, or a unit cost of 2 rubles.

Costs of the second stage of manufacture (in rubles) are as follows:

Direct labor	25,000
Material and other costs	5,000
4,800 cubic meters of clay	9,600
Workshop overhead	7,500
Total cost of 1,600,000 clay bricks	47,100

Cost of 1,000 unfired bricks, 29.4 rubles.

The costs of the third stage of manufacture (in rubles) are as follows:

Direct labor	5,000
Fuel, material, and other costs	10,000
Cost of raw brick (1,500,000 at 29.4 per thousand)	44,160
Overhead	1,500
Total cost of 1,450,000 fired bricks	60,660

Cost of 1,000 fired bricks, 41.9 rubles.

In enterprises with a complex manufacturing process which produce several types of products, the calculation of costs is more complicated. The following example will illustrate:

An enterprise which operates two factories manufactured 1,600 units of product A and 2,000 units of product B. Factory No 1 made 1,800 components for product A and 2,200 components for product B. The following table lists costs for both factories.

Cost of Semifinished Products

Factory No 1	Product A	Product B	Over-All Cost
Direct labor	100,000	200,000	
Material and other costs	50,000	70,000	
Factory overhead			60,000

Cost of Finished Products

Factory No 2	Product A	Product B	Over-All Cost
Direct labor	40,000	80,000	
Material and other costs	10,000	20,000	
Factory overhead			18,000
Enterprise overhead			42,000

Both the factory overhead and the total plant overhead were apportioned on the basis of labor cost, as follows:

Factory No 1

Product A $\frac{60,000 \cdot 100,000}{100,000 + 200,000} = 20,000$ rubles

Product B $\frac{60,000 \cdot 200,000}{100,000 + 200,000} = 40,000$ rubles

Factory overhead = 60,000 rubles

Factory No 2

Product A $\frac{18,000 \cdot 40,000}{40,000 + 80,000} = 6,000$ rubles

Product B $\frac{18,000 \cdot 80,000}{40,000 + 80,000} = 12,000$ rubles

Factory overhead = 18,000 rubles

The enterprise overhead is calculated as follows:

Product A in Factory No 1 (semifinished) $\frac{42,000 \cdot 100,000}{100,000 + 200,000 + 40,000 + 80,000} = 10,000$ rubles

Product B in Factory No 1 (semifinished) $\frac{42,000 \cdot 200,000}{100,000 + 200,000 + 40,000 + 80,000} = 20,000$ rubles

Product A in Factory No 2 $\frac{42,000 \cdot 40,000}{100,000 + 200,000 + 40,000 + 80,000} = 4,000$ rubles

Product B in Factory No 2 $\frac{42,000 \cdot 80,000}{100,000 + 200,000 + 40,000 + 80,000} = 8,000$ rubles

Calculation of costs on a unit basis is illustrated in the following table:

Unit Cost Schedule

Kind of Cost	Factory No 1 (semifinished products)		Factory No 2 (finished products)	
	Product		Product	
	A	B	A	B
Direct labor (rubles)	100,000	200,000	40,000	80,000
Material and other costs (rubles)	50,000	70,000	10,000	20,000
Semifinished products (rubles)			160,000	300,000
Factory overhead (rubles)	20,000	40,000	6,000	12,000
Enterprise overhead (rubles)	10,000	20,000	4,000	8,000
Total	180,000	330,000	220,000	420,000
No of semifinished products	1,800	2,200		
Actual cost of semifinished products per unit (rubles)	100	150		
No of finished products			1,600	2,060
Actual cost of finished products per unit (rubles)			137.5	210

Number of Units Produced

Product A (semifinished)	1,800
Product A (completed)	1,600
Product B (semifinished)	2,200
Product B (completed)	2,060

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